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ORIGINAL PAPER

MENISCECTOMY: A REVIEW OF 1,723 CASES

By C. B. WYNN PARRY, P. J. R. NICHOLS, and N. R. LEWIS

From the R.A.F. Medical Rehabilitation Units, Chessington and Collaton Cross

TEARS of the semilunar cartilages of the knee-joint are a common disability in the Armed Forces. Almost all Royal Air Force patients operated on for removal of torn cartilages receive post-operative treatment at the Royal Air Force rehabilitation centres.

During the last eight years over 1,700 such patients have been treated at two Medical Rehabilitation Units, at Chessington and Collaton Cross. Although several series have been reported in the literature, notably by Smillie (1951), Bristow (1944), McMurray (1944), Henderson (1930), and MacAusland (1931), there are few published accounts of the important factors in post-operative rehabilitation. This paper is concerned mainly with an analysis of these factors.

INCIDENCE OF TORN CARTILAGES

Some 2,500 patients are treated every year at the two centres, and about one-third of these are suffering from some form of knee disability. Of these patients with knee disorders, 30% are undergoing rehabilitation following meniscectomy.

There were 1,723 cases in this series, and in 1,611 the knee affected was recorded: in 853 it was the right and in 758 the left—a ratio of 1·2 to 1. For 1,670 cases it was known which cartilage was affected: in 1,148 it was the medial and in 522 the lateral, giving an incidence of 2·2 to 1. This is close to Smillie's incidence of 1·8 to 1 and bears out the general impression among orthopaedic surgeons that the larger the series the higher the proportion of lateral cartilage

tears. Lantzounis (1931) found an incidence of 8 to 1 in 142 cases, Bonar (1950) of 10 to 1 in 200 cases, and Henderson (1934) of 10 to 1 in 344 cases.

In 17 patients (1%) there were tears of more than one cartilage—significantly less than in Smillie's series, where the incidence was 5%. In 76 (4·4%) previous operations for removal of another cartilage had been undertaken: 31 patients had had previous total right medial meniscectomy; 17 left medial, 9 right lateral, and 9 right medial meniscectomy; in 8 cases posterior horn remnants and in 2 cases regenerated medial cartilages had been removed.

All patients were operated on by Service orthopaedic surgeons. The majority of surgeons were in the Royal Air Force Medical Service and thus a constant regimen was applied to most patients.

CAUSES OF INJURY

Sport in some form was the cause of the injury in 69% of the cases, and no less than 51% were due to Association football. This agrees closely with the figures of Lantzounis (40%) and of Luck *et al.* (50%). The other main specific causes were Rugby football 7%, twists 21%, and direct violence 3%. No ascertainable cause could be found in 5%.

Torn cartilages resulted from almost every type of sport, even swimming. The incidence of causes was the same for medial and lateral tears, except that on assault courses there were six times as many tears of the medial cartilage as of the lateral cartilage.

Luck *et al.* (1948) state that poor muscular development in recruits playing games was a potent cause of torn cartilages. It is quite certain that a large number of patients tear their cartilages at the beginning of a season when they are not in full training and their quadriceps mechanism is not "toned up" to the job. It would be interesting to compare the incidence of cartilage lesions in a group of men who had carried out intensive quadriceps drill as part of their pre-season training with that in a control group without such exercises, and we hope to undertake such an investigation in the future.

The 1,723 cases in this series represent a loss of 300 man years, or over 100,000 working days. Since it must surely be possible to prevent some of the injuries by carefully supervised training and playing conditions, these figures present a challenge which must be met.

TYPES OF LESION

Table I shows the lesions found at operation on the 1,275 patients for whom operation records were available.

The main lesions found at operation for *medial* meniscectomy were: bucket-handle tear in 40%, posterior horn detached or torn in 18%, peripheral

tears in 9%, and anterior horn torn in 8%. In 8% a normal cartilage was found. In patients subjected to operation for *lateral* meniscectomy, bucket-handle tears were found in 21%, cysts or torn cystic cartilage in 19%, detached or torn posterior horn in 19%, and peripheral detachment or tears in 8%. In 3% the cartilage

TABLE I

LESIONS DISCOVERED IN 1,275 MENISCECTOMIES

Type of Lesion	Medial Meniscectomy	Lateral Meniscectomy
Longitudinal tears:		
(*a*) Complete bucket-handle	357	87
(*b*) Anterior horn	74	24
(*c*) Posterior horn	118	64
(*d*) Posterior horn detachment	41	15
Transverse tears	9	26
Unspecified tears	70	35
Peripheral tears	47	9
Cysts:		
(*a*) With tears	0	13
(*b*) Without tears	1	64
Loose cartilages	35	20
Peripheral detachment	33	25
Normal cartilages	58	11
Miscellaneous:		
Loose bodies	2	2
Hypertrophic	4	0
Very small cartilages	4	0
Dislocated cartilages	4	6
Tags of cartilage	2	3
Discoid cartilage	0	5
Thickened cartilage	0	2
Posterior horn remnant	2	0
Adhesions	1	0
Regenerated cartilages	1	1
Total	863	412

was normal. In the whole series, taking medial and lateral meniscectomies together, the incidence of normal cartilages found at operation was 6·2%. Thus there were twice as many bucket-handle tears in medial cartilages as lateral tears, but the numbers of anterior horn tears, posterior horn tears, and peripheral tears were almost identical. Normal cartilages were removed less often when a lateral cartilage tear had been diagnosed.

Table II compares the incidence of the various types of lesion with that found in other series reported in the literature. Our figures conform to those of Smillie.

TABLE II

INCIDENCE OF TYPES OF LESION IN DIFFERENT SERIES

Type of Lesion	Lantzounis (1931)	Henderson (1934)	Fisher (1933)	Bristow (1935)	Dunn (1931)	Luck *et al.* (1948)	R.A.F.	Jones (1909)	Smillie (1951)
Bucket-handle tear ..		38·9%	47·5%		25%	43·9%	34·6%		29%
Anterior tear	15·5%		27·8%		14%		8%	45%	
Posterior tear	4·7%		13·9%	31%	46%		18·3%		21%
Peripheral tears or detachments	8%						8%		14%
Hypermobile	36%						4%		
Longitudinal tears ..	19%								
Transverse tears ..	10%								
Normal	0						6·2%		6·3%

SYMPTOMS AND DIAGNOSIS

The main symptoms experienced by patients with a torn cartilage were locking, effusion, giving way, and pain.

The various possible symptom complexes, one symptom alone, or possible combinations such as locking and pain, locking and effusion, and so on, were analysed. It was found that the commonest symptom complexes were locking, effusion, and pain (12%), locking alone (11%), and all four—locking, effusion, giving way, and pain (10%).

The possible symptom complexes were analysed for both medial and lateral meniscectomies to see if presenting symptoms were different in the two groups and might therefore help in diagnosis, but the commonest presenting symptoms were in fact the same for both.

In cases where a normal cartilage had been removed the commonest presenting symptom complex was effusion, giving way, and pain. Locking was only the third most frequent presenting symptom.

Pain was found to be by far the commonest symptom (30%) in patients with cystic lateral menisci; 38% of the patients had no effusion in the knee-joint after the initial accident; 37% never at any time experienced locking; 53% never complained of giving way of the knee; and 45% never complained of pain.

On analysis of the incidence of locking in the main lesions it was found that 76% of the patients who had bucket-handle tears complained of locking. Locking also occurred in 56% with posterior horn tears and 56% with anterior horn tears. Half the patients in whom a normal cartilage was found complained of locking of the knee.

McMurray's Sign

The usefulness of this sign depends entirely on the correct and careful practice of the technique described by McMurray. It is clearly impossible to be sure that all the examiners whose results we have analysed performed the test in the same manner, but the results are, notwithstanding, of interest (Table III).

TABLE III
INCIDENCE OF NEGATIVE OR POSITIVE McMURRAY SIGN

Type of Lesion	McMurray Sign		
	Positive %	Negative %	Equivocal %
Bucket-handle tear	74	17	9
Anterior horn tear	76	16	8
Posterior horn affections	70	20	10
Peripheral tear or detachment ..	67	26	7
Normal	65	24	13
Cyst (lateral only)	51	43	6

The surprising feature is that, lateral cartilage cysts excluded, the incidence of positive, negative, or equivocal results is remarkably similar for each type of lesion; this despite the claim that the test is helpful only in posterior and complete tears (Smillie, 1946). The test was actually positive slightly more often for anterior tears than for other tears. There was no significant difference between the results for medial and lateral cartilage tears.

The proportion of normal cartilages removed (6·2%) is very similar to that reported by Smillie (6·3%) and is lower than other series reported (Henderson 18·6%, Dunn 15%). No particular information is gained concerning these normal cases by an examination of the results of McMurray's test or the symptom complexes encountered. Locking was somewhat less frequent, and McMurray's sign was positive in about the same number of patients with normal cartilages as in those with definite tears. As many more normal medial menisci were removed than lateral (7·8% to 2·7%) it would seem that the difficulties of diagnosis of lateral meniscus tears have been largely overcome.

PLAN OF TREATMENT

Patients are normally admitted to hospital two days before operation in order that they may be instructed in quadriceps exercises. Patients with very weak quadriceps are admitted several days before operation for intensive exercises or treated pre-operatively at a medical rehabilitation unit.

A standard vertical incision is used. Static bracing exercises under the supervision of a physical training instructor start as soon as the anaesthetic wears off. Should a good contraction not be obtained within the first 24–48 hours after operation, electrical stimulation is used to reinforce the patient's efforts, but only until he can perform the exercises himself.

On completion of the operation a pressure bandage is applied from mid-calf to mid-thigh. This is not disturbed until the tenth day when the stitches are removed, except on the rare occasions when faradism has to be given. Free flexion is allowed, but not insisted on, after the tenth day. Weight-bearing in a back splint is allowed after the seventh day. Most patients are transferred to a medical rehabilitation unit between the fourteenth and twenty-first days, and in recent years the tendency has been to transfer them by the fourteenth or fifteenth day when possible.

On arrival at the medical rehabilitation unit patients are assigned first to a non-weight-bearing class, where they build up the power of the quadriceps with static exercises and games. Effusions are treated in full-time back splint and pressure bandage until the effusion has completely disappeared (Millard and Wynn Parry, 1953).

When the quadriceps are of good power and there is no effusion, usually after six to eight days, the patients graduate to knee-flexion exercises and partial weight-bearing. Six hours' treatment a day is given. Should their trade be physically demanding, a final period is spent in a programme of vigorous exercises and games to restore full function and confidence. The medical rehabilitation unit is designed to return patients to duty for their particular trade as quickly as possible. Thus a clerk returns to duty sooner than an aircraft engineer, whose job may involve clambering over large aircraft on an exposed airfield.

The time in hospital varies, for many reasons. The longer the stay in hospital the longer the period of rehabilitation necessary. The average time spent at the rehabilitation unit was 30 days when the patient had been in hospital four weeks, as compared with 23 days if in hospital only two weeks. If, however, a patient spends more than one month in hospital this is no longer true, because he will have had an extended period of quadriceps exercises in hospital.

As would be expected, the total time off duty increases with time spent in hospital. The quicker the patients are transferred to medical rehabilitation units after the fourteenth day the quicker they return to duty. The average total time off duty was 46 days when the period in hospital was three weeks or less, 55 days when the period was four weeks, 63 days when five weeks, and 78 days when over six weeks.

Most authors are agreed that the average time between onset of symptoms

and operation is many months or even years. In the present series over 40% had had symptoms for one year or longer before operation, and Fig. 1 shows the length of time between onset of symptoms and operation for the 1,293 patients for whom the times were known accurately.

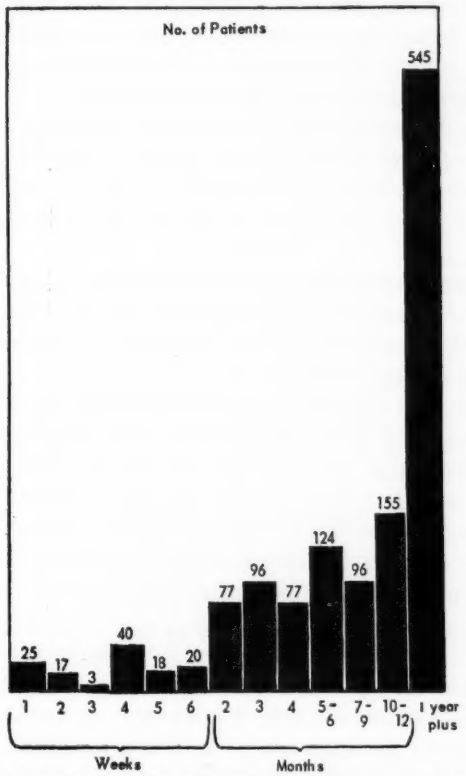

FIG. 1.—Length of time between onset of symptoms and operation. (Facts known for 1,293 patients. Includes complications.)

It was thought that comparison between the over-all rehabilitation time and the length of time the patient had had symptoms before operation would prove of interest. It might be thought that a patient who had had symptoms for over a year before operation would take longer than one who had symptoms for only a short time. It was, however, found that the length of time symptoms had been present before operation had no effect on the treatment time. The total time off duty was, on the average, 60 days when the patient had had symptoms for two months or less, and 64 days when symptoms had been present for a year

or more. There was no difference in the time off duty between patients who had a medial meniscectomy and those who had a lateral meniscectomy.

Quadriceps Drill

The main object of post-operative treatment is to restore the quadriceps to full function. It has been stressed many times in the literature that knee function depends entirely on a good quadriceps extensor apparatus. The figures presented here bear out this truth with startling clarity.

On arrival at the centre patients were classed as having *good* muscle power if they could raise the straight leg against strong resistance, *fair* if the leg could be raised against slight resistance, and *poor* if it could not be raised off the couch at all. In 40% the power was graded as fair on arrival at the centre, in 30% good, and in 30% poor.

The average time under treatment at the centre was 48 days when the power was graded as poor on arrival, and 37 days if fair or good. On arrival there was no significant difference in the power exhibited by patients suffering from medial and lateral cartilage tears.

It is therefore vital that the patient be instructed carefully in quadriceps drill before admission to hospital, that he works hard on his muscles immediately before and after operation, and that the remedial gymnast or physiotherapist takes ward quadriceps exercises regularly. Six times a day is not too often for group exercises, and ten minutes of exercises per hour should be obligatory.

Faradism has no place in routine treatment after meniscectomy, and it is only of use when gross inhibition is present (Millard, 1952).

Effusion

A slight effusion is common when intensive rehabilitation starts, but in the straightforward cases should not hold the patient back. In the Royal Air Force the rehabilitation units are unavoidably situated long distances from many of the hospitals, and long journeys may thus produce effusion into the knee. Experience has shown that, provided all patients wear a back splint and pressure bandage for the journey and do not carry heavy kit, gross effusions do not often occur. However, patients vary as regards the sensitivity of their synovial membranes and some effusions are unavoidable. We found the best treatment to be complete and continuous immobilization of the knee in a back splint (Millard and Wynn Parry, 1953).

Effusions were graded clinically as: 0, no effusion; 1, a trace; 2, obvious effusion; 3, gross effusion. On arrival 44% had no effusion, 35% Grade 1, and 17% Grade 2. On discharge 91% had no effusion, 7·6% Grade 1, and 1·3% Grade 2.

It will be seen that 8·9% of patients were discharged to duty with effusions. Provided the patient has excellent quadriceps and sound ligaments, there seems no reason why the persistence of a mild effusion in the absence of any other evidence of pathology in the knee should prevent him from returning to work. In such circumstances duties are modified and games restricted temporarily, the patient being reviewed monthly. It seems that some patients produce synovial effusions with minimal trauma, and the effusion can safely be disregarded. The bigger the effusion on arrival at the centre the longer was the time spent under treatment. With no effusion on arrival the treatment time was, on an average, 30 days; with Grade 1 effusion, 36 days; with Grade 2, 41 days; and with Grade 3, 48 days.

Movements

The return of full movement after an operation for removal of a torn cartilage presents little or no problem. Even those patients whose knees were immobilized for many days to disperse effusions regained movements rapidly.

On discharge from the unit 94% of patients had full movement in the knee. Some limitation of range (average, 20 degrees of flexion) was found with greater frequency after lateral than after medial meniscectomy.

COMPLICATIONS

a. Ligament Laxity and Tears

The incidence of torn ligaments in the present series was 0·5%, while Lantzounis found that 2·6% of his series had torn cruciate ligaments, and Luck reported 4·3% with associated rupture of cruciate or lateral ligaments.

Laxity of cruciate ligaments was diagnosed in 2·5% and collateral ligament laxity in 2%.

b. Osteoarthritis

Definite radiological changes of osteoarthritis (narrowing of the joint space and osteophyte formation) were present in 65 cases, an incidence of 3·8%. The incidence of osteoarthritis associated with medial cartilage tears (34 cases) was 2·9%, and with lateral cartilage tears (23 cases) 4·4%. The numbers of cases of osteoarthritis analysed according to the duration of symptoms before operation were: 1–6 weeks, 1 case; 2–3 months, 4; 4–6 months, 5; 7–9 months, 2; 10–12 months, 8; 1 year or more, 37 cases. It is clear that the longer the patients have symptoms the greater is the risk of osteoarthritis, and this reinforces the exhortation often repeated in the literature that as soon as a torn cartilage has been diagnosed it should be removed without delay.

c. Associated Cartilage Tears

Before rehabilitation was completed 48 patients were returned to hospital suffering from a tear of another cartilage.

d. Gross Effusions

Sixty patients were classed as having gross effusions for over three weeks and required aspiration, and some needed repeated aspiration. In few instances could any definite reason for the effusion be discovered, but all these cases took considerably longer to regain function because of the long time required for the quadriceps to build up to satisfactory power.

e. Osteochondritis Dissecans

A full account of a series of 75 cases from these units has appeared elsewhere (Lewis and White, 1955). In the present series 42 cases had associated osteochondritis dissecans—an incidence of 2·4%. Lantzounis found an incidence of 0·9%, and Luck one of 2·4%. In 12 cases the medial femoral condyle was affected, in 8 the lateral femoral condyle, in 1 the tibial condyle, but in 21 the site was unspecified. In 31 cases a torn cartilage was found, 12 of these being of the bucket-handle type. In 5 cases the cartilage was normal, in 2 it was loose, and in 4 no details were given. In only 6 cases was the presence of osteochondritis dissecans suspected pre-operatively. Lewis and White found that 36% of cases of osteochondritis dissecans were first diagnosed at operation for meniscectomy.

Of the 42 patients, 17 returned to full duty, 19 to modified duty, 5 were discharged to hospital for removal of loose bodies, and 1 was invalided from the Service. The average time of treatment from operation to discharge from the medical rehabilitation units was 67 days (8 days longer than the average uncomplicated case of meniscectomy).

f. Other Complications

These included post-operative haemarthrosis (14 cases), persistent and disabling pain (14 cases), chondromalacia patellae (11 cases), tuberculosis of knee (2 cases), septic arthritis of knee (2 cases), and psychiatric disorders (5 cases).

There were 5 patients who were not considered suitable for rehabilitation because they would not work and behaved with a degree of irresponsibility that made it impossible to retain them at the unit. It has been found better to discharge such patients to prevent them "infecting" others rather than attempt repeated punishment. The less formal the discipline in a rehabilitation unit the better the spirit and the patients' self-discipline.

g. Normal Cartilages

From 69 patients 69 normal menisci were removed. In 59 no cause for symptoms was discovered, but in the others the cause of symptoms was found to be osteochondritis dissecans in 5, osteoarthritis in 1, tuberculosis in 1, and chondromalacia patellae in 1; in 2 the other cartilage was torn. The average time these patients were under treatment was 67 days.

ANALYSIS OF RESULTS

Of the 1,723 cases in the series, 1,276 (74%) were discharged to full duty; 356 (21%) were discharged to modified duty; 67 (3·9%) were discharged to hospital; 19 were invalided from the Service; and 5 were unsuitable for medical rehabilitation unit treatment. Of those returned to modified duty, many were in trades demanding a high degree of arduous duty. Most of the Royal Navy and Army personnel are required to be A1 before returning to full duty.

The majority of patients were back to full employment categories three months after discharge from the unit. Those discharged to hospital were mainly patients requiring further operative treatment for torn cartilage, retained posterior horn, or removal of loose body, or the treatment of an unassociated disability. Those invalided included the psychiatric cases and some patients with osteoarthritis of a severity that prevented them performing the duties required by their trade.

Luck states that in his series "a rather high percentage were temporarily reclassified". In this series 74% returned immediately to full duty and 95% were fit for some form of duty on discharge from the unit.

TIME UNDER TREATMENT

The average time under treatment from day of operation to day of return to duty was: (1) for all patients, 62 days; (2) for patients without complications, 57 days; (3) for patients with complications such as gross osteoarthritis, ligament tears, osteochondritis dissecans, post-operative haemarthrosis, etc., 87 days.

The average time under treatment for all cases with medial cartilage lesions was 63·5 days, and for all lateral cartilage cases 61 days. Thus there is no significant difference between the recovery time for medial and lateral meniscectomies. Fig. 2 shows the total treatment time for 1,179 uncomplicated meniscectomy cases: 71·6% of patients were back to duty within nine weeks, and nearly one-half were back within seven weeks, of the operation.

Those that obtain really speedy recoveries are the exceptionally fit men, such as physical training instructors and the first-rate senior N.C.O.s, because in the first instance they have an excellent musculature to work on and they

understand what is required of them immediately they are shown. In addition they have a real incentive to work, and pride themselves on the example they set to the other members of the class and vie with each other to be the first to leave. In three such cases the patients had to be restrained from working too hard, for they were attempting to regain too high a standard of fitness too quickly. Cleveland (1944) found that officers and N.C.O.s were twice as likely to achieve full duty as other ranks.

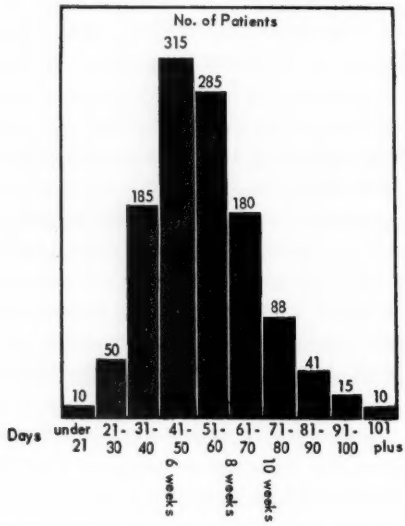

FIG. 2.—Total time off duty (from date of operation to return to duty) in 1,179 cases of meniscectomy.

The patients who take ten weeks or longer to recover fall into two main groups. In the first group are those with little or no incentive to get fit quickly and, without being malingerers, spin out their stay if they possibly can. Under the vigilant eyes of the instructors this is never easy, but as complete quadriceps rehabilitation is entirely due to the patient's own efforts it is not difficult for him to take longer than he need to get fit. As Willien (1945) pointed out, "emotional stability is as important for satisfactory rehabilitation as the knee pathology". The second and larger group is composed of those who have poor musculature from the outset, and this is mainly due to their never having developed worthwhile muscles. A high proportion of recruits in the Service to-day appear never to have taken regular exercise or played any form of game since leaving school.

Smillie (1946) states that "experience has shown that recovery to a degree of physical fitness justifying an Army category of A1 is rarely possible in less than twelve weeks of organized rehabilitation". This applies in an equal degree to those engaged in the manual occupations of heavy industry.

Wide variations in period of treatment are recorded in the literature, and the results in this series have been achieved rather more quickly than in some others, possibly because treatment is more intensive at the R.A.F. centres. In Table IV the results given by various authors are compared with those in the present series.

TABLE IV

TREATMENT TIME (DAYS) IN MENISCECTOMIES BY VARIOUS AUTHORS

Authors	Time in Days from Operation to Return to Work	Occupational Groups
Smillie (1951)	90 approx.	Service and heavy industry
Bonar (1950)	85·3	Miners
Duthie and McLeod (1943)	82·0	Miners
R.A.F.	62·0	Service
Terhune *et al.* (1943) ..	50·0	All types
Bristow (1935)	42–56	All types
Meekison (1944)	42	All types
Lantzounis (1931) ..	38	All types

The experience gained by this analysis may help to reduce the time taken for rehabilitation after meniscectomy. However, there is clearly an optimum time below which it is unwise to return a man to any but the lightest work, as the knee-joint must be allowed time to heal. Furthermore, it is unwise, particularly in the Services, to return a man to duty, however sedentary, before a reasonable time has elapsed after operation (say, five weeks), as even minor trauma may set up an inflammation in the joint, and the quadriceps, susceptible enough to wasting at the best of times, will waste rapidly so soon after operation.

It is our view that for many weeks after operation, even when excellent muscle tone and power have returned, the quadriceps is in a state of balance which may easily be upset. We tell all our patients to continue with twice-daily quadriceps drill for at least a year after operation. Frequently patients are readmitted for rehabilitation at the Royal Air Force centres suffering simply from inadequacy of the quadriceps from letting their muscles become weak after meniscectomy by omitting regular quadriceps drill.

We are firmly of the opinion that there is no substitute for proper static quadriceps exercises, muscle setting, and straight leg raising and holding. Road work, swimming, athletics, etc., do not by themselves build up power and endurance in the quadriceps.

CONCLUSIONS AND SUMMARY

A series of 1,723 patients operated on in Royal Air Force hospitals for removal of suspected torn cartilages is presented. The ratio of medial to lateral tears was found to be 2·2 to 1. Bucket-handle tears were the commonest lesions found at operation, and posterior horn lesions next most common. The incidence of normal menisci removed was 6·2%, and of osteochondritis dissecans 2·4%. Sport was responsible for 61% of the tears, and it is suggested that more enlightened pre-sport training, with attention to building up the power of the quadriceps, might lessen the incidence of cartilage tears and, indeed, all types of knee injury.

The various symptom complexes are described and their frequency analysed. Locking occurred in 62% of cases, but in approximately one-third of the cases no locking occurred. In approximately one-third no effusion developed. In over half no giving way was observed, and in just under one-half no pain was felt.

McMurray's sign was positive in approximately 75% of patients with proved cartilage tears, although there was no significant difference in its incidence in different types of tear. In 50% of cases in which normal cartilages were removed McMurray's sign was positive. A careful history offers the best chance of correct diagnosis.

Complications included gross effusion, osteoarthritis (3·8%), osteochondritis dissecans (2·4%), and torn ligaments (0·5%).

The main factors in speedy recovery are the early development of a good quadriceps muscle, and the absence of effusion at the start of intensive rehabilitation. Recovery time was, on an average, 11 days longer in patients whose muscles were graded as poor on arrival at the rehabilitation centre than in those whose muscles were graded as good. Recovery time was, on an average, 18 days longer in those cases where a gross effusion was present on arrival at the rehabilitation centre as compared with patients who had no effusion.

In 94% of cases full movements were obtained before discharge and the regaining of movement offered no problem; 74% of patients returned to full duty and 21% to modified duty.

In view of the nature of Service medicine no follow-up has been attempted. The average time under treatment from day of operation to day of return to duty was 56·8 days in uncomplicated cases and 62 days in all cases. Treatment time at the rehabilitation unit was increased in proportion to the time spent in hospital.

It is suggested that, in the light of experience afforded by this survey, the average patient should be back at work by nine weeks after meniscectomy, and that this figure could be reduced to six weeks, but probably it would be unwise to lower it further.

Acknowledgments

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ORIGINAL PAPER

CHANGES IN THE CERVICAL SPINE IN RHEUMATOID ARTHRITIS WITH COMPRESSION OF THE CORD

WITH REPORTS OF FOUR CASES

By GEOFFREY STOREY

From the Department of Physical Medicine, Hackney Hospital, London

It has now been recognized that changes in the cervical spine may interfere with conduction in the spinal cord, resulting in paraplegia. Recently Sharp (1957) has reported subluxation of the cervical vertebrae in ankylosing spondylitis with cord compression and also described this in rheumatoid arthritis, although he stated that in this condition neurological complications were not common.

The present paper describes four cases where rheumatoid arthritis was associated with changes in the cervical spine. In one case death occurred and in two severe paraplegia, while in the fourth the neurological signs were slight.

DETAILS OF CASES

Case I

A woman aged 53, when first seen in June, 1955, gave a history of three years' progressive pain and limitation of movement in many of her joints; pain in the neck had always been a prominent feature. She had attended several hospitals, and on one occasion manipulation of her neck had been performed, at another time she had been provided with a cervical collar.

On examination she presented a typical picture of severe rheumatoid arthritis. There were limitation and pain on movement of the cervical spine, elbows, shoulders, and knees; also typical deformity of the hands and limitation of movement of the wrists. The other systems were normal. Haemoglobin, 57% (Haldane); E.S.R., 56 mm. in 1 hour (Westergren). Radiography showed severe changes in the cervical spine with dislocation upwards of the second cervical vertebra (Plate II, Fig. 1). In addition there were erosions of the clavicle and upper ends of the humerus (Plate II, Fig. 2). She had various forms of treatment, including cortisone injections, but became progressively disabled and could only walk with crutches. On October 2, 1956, she was admitted to hospital with loss of use of her arms and legs. Although there was no gross alteration in reflexes, neurological assessment was difficult in the presence of severe arthritis. She was provided with a collar, but died suddenly 18 days later.

Post-mortem examination revealed signs of severe rheumatoid arthritis. There was subluxation of the odontoid process through the foramen magnum compressing the spinal cord backwards. The outer ends of the clavicle were eroded and the manubriosternal joint was freely mobile.

PLATE II

FIG. 1.—Case I. Subluxation forwards of the atlas with the odontoid peg displaced upwards. Changes are also present in C5 and C6.

FIG. 3.—Case II. Destructive changes in the cervical vertebrae (C3 and C4).

FIG. 2.—Case I. Erosions of the head of the humerus and disappearance of the outer end of the clavicle.

FIG. 1.—Case III. Subluxation of C4 vertebra on C5.

FIG. 3.—Case IV. Myelogram showing a block at the level of C4.

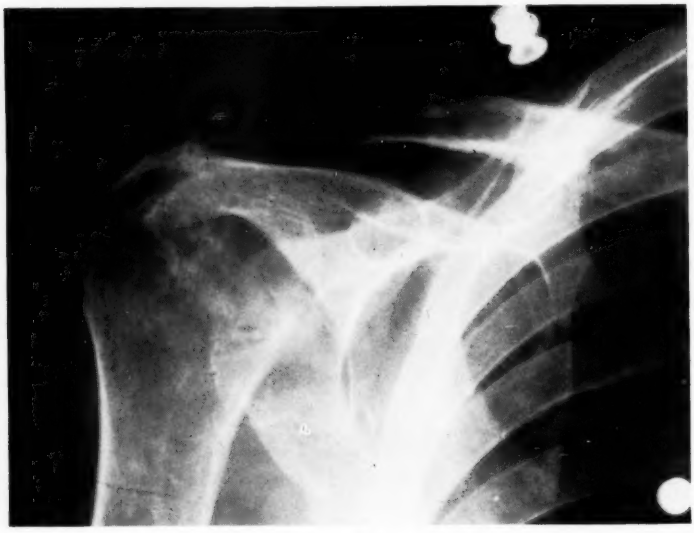

FIG. 2.—Case III. Small erosions of the head of the humerus and disruption of the acromio-clavicular joint.

Case II

A woman aged 63 had for many years had multiple joint pain and swelling and had been unable to walk for the past 18 months; her knees had become progressively contracted. On examination there were signs of severe rheumatoid arthritis involving hands, shoulders, feet, and knees. In addition she had a paraplegia inflexion with signs of a cord lesion at C5 level, sensory disturbances, spasticity, extensor plantar responses, and increased tendon reflexes. Radiographs of the cervical spine showed forward displacement of C4 and C5 vertebrae (Plate II, Fig. 3).

She was transferred to University College Hospital, where an operation was performed by Mr. C. W. Flemming. The lamina of C3 was found to be pressing on the posterior aspect of the cord. The larger part of this lamina was removed together with the lamina of C4. Bone-grafting was performed between C2 and C5. After operation there was slight return of movement in the limbs, but the patient has remained bedridden.

Case III

A woman aged 74 began 19 years ago to have pain in the hands. Later her knees became affected and then other joints including her back, until recently walking became impossible. Examination showed general lymphadenopathy with muscle wasting. The knees, shoulders, hands, and neck were affected by typical rheumatoid arthritis, with limitation of movement of the cervical spine. The weakness and wasting made it difficult to assess the neurological signs, but the reflexes were all brisk and there was an extensor plantar response on the right. X-ray examination revealed subluxation of C4 vertebra on C5 (Plate III, Fig. 1). The knee showed advanced rheumatoid arthritis, and there were erosions in the head of the right humerus with destruction of the ends of the clavicle (Plate III, Fig. 2). She was provided with a collar, but is able only to sit up and is unable to walk.

Case IV

A woman aged 61 had for eight years swelling of the right knee following a fall. Subsequently there was a gradual spread of pain and swelling to other joints, and for one year she has been unable to walk and for the last four weeks unable to use her fingers or raise her arms. Examination showed signs of severe rheumatoid arthritis in the fingers, wrists, knees, and shoulders, with weakness of the wrists and fingers. In the lower limbs there was slight movement only. Tendon reflexes were all increased, and ankle clonus and bilateral extensor plantar responses were elicited. There was loss of sensation at the level of C6 in the right arm. E.S.R., 48 mm. in 1 hour (Westergren). A myelogram (Plate III, Fig. 3) showed a block at the level of C4–5 interspace. A decompression laminectomy of C5 was performed in November, 1956, at the London Hospital. This was followed by a little improvement, but the patient remained unable to stand.

DISCUSSION

The changes in the cervical spine in the four cases here described appeared to be the result of rheumatoid arthritis. Clinically they all had typical rheumatoid arthritis of a severe type of long duration. In Cases I and III destructive

changes were marked; these included destruction of the outer end of the clavicle with disorganization of the acromio-clavicular joint, and it seems likely that such changes were directly responsible for the disorganization of the cervical spine. Erosions and destructive changes (arthritis mutilans) in the bones occur in rheumatoid arthritis (Jonsson, 1949; Mather, 1954), and bony erosions have been described in ankylosing spondylitis (Hart, 1955), although arthritis mutilans does not usually occur in this condition. Arthritis mutilans is, however, particularly associated with psoriasis (Gribble, 1955; Sherman, 1952), although Sherman believes that the X-ray appearances differ from those of rheumatoid arthritis. There was, however, no evidence of psoriasis in any of our patients. Warin *et al.* (1957) have described a type of polyarthritis with widespread bony erosions and destruction due to reticulo-histiocytosis. The papular eruption xanthelasma palpebrarum and other features present in their cases were absent from those here recorded.

In Case I manipulation had been performed, and, although it cannot be directly associated with the death of the patient, it can only have done harm by increasing the destruction already present; indeed, it seems that in rheumatoid arthritis manipulation of the neck should never be attempted.

SUMMARY

Four cases of rheumatoid arthritis are described where changes in the cervical spine had produced neurological signs by pressure on the cord. Death occurred in one case. Erosive changes were marked in two cases and seem to have been responsible for the subluxation of the vertebra.

Manipulation of the cervical spine in rheumatoid arthritis appears to be contraindicated.

ACKNOWLEDGMENTS

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REVISION SERIES

CEREBRAL PALSY

By D. C. ARNOTT

SINCE the war the public conscience has been stirred by the problem of cerebral palsy. A new comprehension of the condition and all that it implies has arisen, and a more positive attitude towards its treatment and management is rapidly developing. Treatment centres are springing up throughout the country, bringing to light many new problems of diagnosis, treatment, education, and administration. A fundamental lack of knowledge of applied neurophysiology has been demonstrated.

The infantile cerebral palsies can be defined as non-progressive conditions of malfunction of the brain which manifest themselves essentially as disturbances of normal movement. They are produced by a variety of different causes—prenatal, perinatal, and post-natal—which damage the immature brain. Associated handicaps—auditory, visual, intellectual, sensory, convulsive, and of speech—may complicate the diagnosis and treatment.

Such a definition must not be adhered to too rigidly. First, any child who would benefit from "cerebral palsy" facilities should not be excluded because the pathological process is progressive rather than static; secondly, it would be quite wrong for a therapist to regard any case of cerebral palsy in childhood as a static disability. Both in health and in disease, especially during early childhood, there is constant neurophysiological change.

It has been customary to amplify the diagnosis of cerebral palsy to describe the distribution and type of the motor defect: hemiplegia, monoplegia, diplegia, paraplegia, and quadriplegia to describe the distribution; spastic, athetoid, ataxic, atonic, and rigid to describe the outstanding locomotor abnormality. Some authorities lay great stress on the typing of the locomotor dysfunction, for on it they base and vary treatment. It would be a mistake to think, however, that by amplifying the diagnosis in this way anything fundamental has been added to the understanding of the nature or extent of the pathological lesion.

INCIDENCE

Figures relating to the incidence of cerebral palsy vary between 1 and 4 per 1,000 live births; an average figure would be about 1·7 per 1,000. Ingram (1955) found the incidence in Edinburgh to vary—1·1 per 1,000 in 1950–2 and 2·3 per 1,000 in 1954. Andersen (1954) quotes a figure of 1·05 per 1,000 for England, as compared with 2·34 per 1,000 for Norway. Higher figures are quoted from the U.S.A. It is likely that the methods of arriving at these figures vary as much

as the true incidence itself. From British average figures it is estimated that in a population of one million there will be 27 new cases of cerebral palsy per annum, and at any one time 154 cases in children of school age requiring special schooling. In this population sample there will be a total of about 1,800 victims of cerebral palsy, of whom more than 50% should find an effective place in society.

Ellis (1957) has put into perspective the problem of cerebral palsy from the administrative educational point of view. He quotes figures from Newcastle upon Tyne showing that out of every 1,000 registered school-children 100 are educationally subnormal; 15–30 have speech defects; 10–20 are delicate, 10 maladjusted, 5–8 physically handicapped, 2 deaf, and 1 partially sighted; 1 has cerebral palsy, 0·3 total blindness, and 0·2 epilepsy.

It is suggested that the incidence of cerebral palsy is on the increase, in spite of considerable success in the prophylactic treatment of such conditions as Rh incompatibility. This increase is the price that society has to pay for improved midwifery and paediatrics: a larger percentage of pregnancies go to term and more infants, especially those born prematurely, survive.

AETIOLOGY

Careful study of established and possible aetiological factors is necessary if the incidence of cerebral palsy is to be reduced. Of prenatal factors, rubella, Rh incompatibility, vitamin-K deficiency, and toxaemia are conditions which can to some extent be controlled. The number of cases of cerebral palsy caused by Rh incompatibility has fallen rapidly over the past few years. At birth prolonged labour, anoxia, trauma, haemorrhage, prematurity, and embolism are the factors which may result in the brain damage which gives rise to cerebral palsy. It is obvious that these perinatal factors are intimately interrelated, and it is not surprising that there is some difference of opinion as to which of the factors is the most significant. Further improvements in midwifery will tend slowly to reduce the incidence of some of the complications which lead to brain damage. Careful study of infants who in the neonatal period show signs of intracranial irritation may reveal a subdural haematoma that might otherwise remain unsuspected, while irreparable damage to the cortex is taking place. Dr. Temple Fay has described a little-known physical sign in this connexion—elicited by percussion of the skull, by which the lesion can be detected and located.

Wider knowledge of the role of vitamin K and of its toxic effects may lead to some small reduction in the incidence of cerebral palsy. It is known that abnormal delivery, long labour, twin pregnancy, and previous abortion and stillbirth are severally statistically linked with increased liability to cerebral

damage. The most constant factor, however, in the pathogenesis of cerebral palsy is prematurity. The immature nervous system of the premature infant cannot tolerate insults, in particular anoxia, in the same way as can the nervous system of a full-term infant. Shelley (1957) states that prematurity is an associated factor in the causation of 50% of all cerebral palsies. Post-natal causes give rise to approximately 10% of all cases. There are many different causes of hemiplegia, and there seems as yet little hope of reducing its incidence. The acute infantile hemiplegia of post-natal origin which occurs either without warning or in association with specific fevers remains little understood. The mechanism in some cases is thought to be haemorrhage and in other cases a demyelinating process. Bacterial and virus meningitis still give rise to untoward sequelae. The treatment of tuberculous meningitis is improving and its incidence diminishing; however, a proportion of affected children still survive with neurological damage. Epidemic encephalitis is uncommon, though the rarer types of encephalitis associated with virus infections are still occasionally encountered.

There remain a hard core of cases in which no cause is found. It is probable, however, that the number of cases of cerebral palsy genetically transmitted is small.

PATHOLOGY

Figures from various sources suggest that, of every 100 cases of cerebral palsy, 80 would clinically be described as spastic and mixed types, and 15 as athetoid; the remaining 5 would be made up of the rarer atonic, ataxic, and rigid types. It is difficult to correlate these figures with the many different lesions described. Chief among these are haemorrhage, thrombosis of the large intracranial venous sinuses, cystic degeneration, kernicterus, status marmoratus, diffuse gliosis, agenesis, microcephaly, the "walnut brain", and hydrocephalus. The pathologists discriminate between the pathology of symmetrical antenatal diplegia and that of the asymmetrical double hemiplegia, the microscopic lesion being diffuse in the former.

DIAGNOSIS

The importance of early diagnosis cannot be too greatly stressed, as the success of locomotor training and of treatment generally depends so much, especially where there is spasticity, upon the age when treatment begins, 80% of brain growth occurring in the first three years of life.

Craig (1950) has shown that it is worth while to follow up those children who in the neonatal period have shown signs of cerebral irritation. Although by far the higher proportion of these children (9 out of 10) develop perfectly normally, 1 in 10 will eventually show evidence of neurological abnormality.

Therefore a follow-up of these cases at one year might well detect abnormalities at an age when treatment is so important.

Except in some cases of severe hemiplegia, no definite abnormality will be apparent in the first four or five months. It is possible, however, that during this period some indefinite abnormality may be noticed by an intelligent mother. The baby may be unnaturally "floppy", may lie abnormally still, may not kick at bath-time, or may wave his arms in an unusual way. The face tends to escape the locomotor abnormality, as facial movements are at first largely emotionally controlled. Neither in normal nor in abnormal children is the locomotor cortex active at birth; movements in the first four months are of spinal and reflex character. Failure of the reflex movement patterns to undergo normal modification from 4 months onwards may be the first indication that something is amiss. It is said that failure of reflex activity to become modified in any direction at this time probably denotes mental deficiency. With cerebral palsy modifications occur, but are in the direction of abnormal and increasing reflex activity. Normally spinal reflex activity is slowly replaced by higher reflex reactions, which in their turn give way to voluntary controlled purposeful movements. The normal neonate exhibits preponderance of flexor tone and adopts an attitude of flexion. The limbs resist passive extension. There is a positive grasp reflex. The infant held upright under the arms has very little control over his head, and the legs are flexed and drawn up. There is a positive "startle" reaction. This reflex is seen in the normal child in diminishing degree up to the age of 6 months. If the couch on which the child is lying supine is struck there follow abduction and extension followed by adduction and flexion of all four limbs, particularly the arms. The influence of tonic neck reflexes, and especially the tonic asymmetrical neck reflexes, may occasionally be seen around the age of 2 to 4 months, but in the normal child they are never strong enough to interfere with movement. Certain spontaneous movements such as yawning, blinking, fanning of the toes, shivering, arching the back, stretching, and hiccuping may occur, but they show no evidence of volition. In the normal baby, slowly at first from the third month, extensor tone develops. While lying prone the baby begins to raise his head or to turn it sideways, to extend his spine against gravity, and later to support himself on his extended arms.

It is at this stage, when flexor tone gives way to developing extensor tone, that the spasticity of a "spastic" child becomes apparent. The influence of the tonic reflexes gaining in strength rather than diminishing prevents normal locomotor development. The abnormal reflex activity behaves in a predictable fashion. It is by eliciting abnormal activity of the tonic reflexes that early diagnosis of abnormal spasticity may be made. In a severe case spasticity soon becomes obvious, but in more mildly affected children this develops later, and

to establish an early diagnosis abnormal spasticity may have to be provoked by special handling.

Athetoid children do not usually show abnormal movements before the twelfth to eighteenth month. In the early months they may appear hypotonic and may hardly move at all. When picked up they are "floppy". The legs may be widely abducted and flexed, and there is usually an abnormal degree of dorsiflexion at the ankle-joints. In the early months, however, some aimless waving of the arms, described as "window-cleaning movements", may be seen. Out of this flaccid state begin to emerge phases of stiffening when the child tries to move or to maintain posture against gravity.

The normal child at 4 months has begun to move his arms at variable speeds, to grasp objects with his hands, to suck his fingers, and his eyes follow the movements of his hands. Blinking is established, and the eyes will follow a moving light. The grasp reflex is diminishing, especially in the dominant hand, and there is less resistance to passive movements of the limbs. When the child is pulled up from the supine position the head is held steady on the shoulders. There is a gradual transition from reflex to voluntary movement. Detailed developmental tables are in existence and should be consulted (Gesell and Amatruda, 1949; Griffith, 1954). The child with severe spasticity, on the other hand, when lying on his back, will have stiffly extended legs which resist passive flexion or abduction. The head is strongly retracted and a marked asymmetrical tonic neck reflex can be demonstrated. The hand is clenched with the thumb inside the fingers. The elbows are flexed and the shoulders adducted. Strong resistance is encountered if the arms are flexed or abducted at the shoulder or extended at the elbows.

Bobath, K., and Bobath, B. (1956) found the presence of the following reflexes, among others, the most useful for the demonstration of abnormal spasticity:

1. Asymmetrical tonic neck reflexes—increase in extensor tone in the limbs towards which the face is turned with increase in flexor tone on the occipital side of the body.
2. Tonic labyrinthine reflexes—these produce prominent flexor tone in the prone position and extensor tone in the supine position.
3. Positive supportive reaction—this produces rigid extension of the leg when the ball of the foot touches the ground.

The absence of more highly integrated reflex activity is of equal diagnostic significance. For instance, the absence of the Landau reflex at 10 months, the absence of ability to lift the head when lying prone at 2 months and when supine at 6 months.

Fortunately it is in the presence of spasticity that early treatment of locomotor function can be so rewarding: the more severe the spasticity the earlier is the case likely to be presented for treatment. Athetosis of mixed type must also be treated early.

In mildly affected paraplegic children the disability may not be apparent until later when they try to crawl and to stand up.

The problem, as usually presented to the clinician, is that of a child who is backward developmentally and in whom the cause of the backwardness is undetermined. Is this delay due to neurological motor dysfunction, to a fault in the special senses, to mental defect, or to a combination of these factors? The traditional neurological examination will tell us little. A full history may provide clues as to the likelihood of cerebral palsy. Evidence of abnormalities in the family or in the pregnancy, of complications of labour, of the condition of the infant in the first hours and days after birth, of asphyxia, abnormalities of breathing, crying, or sucking, or any convulsive episode, jaundice, or anaemia, must be sought.

Ruth Griffiths, in her book *Abilities of Babies*, has developed a most helpful method for testing the achievements of the young at different ages according to five different scales: the locomotor, the personal-social, the hearing and speech, the hand and eye, and the performance scales. The tests are designed to demonstrate competence associated with different functions. A "developmental profile" is worked out and compared with normals for the same age. This helps both in diagnosis and in assessment. This developmental profile gives a strong indication as to whether the backwardness is general or is associated with one particular scale. General low scores in all five scales would indicate mental deficiency, but where the backwardness is due to a specific cause, be it locomotor, hearing, or vision, the results would give a strong indication of this by showing a particularly low score in one scale. But, even with her great experience in the subject, Griffiths stresses that serial tests must be made before a low assessment of I.Q. can be accepted as final.

As Foley states, "Although at the upper end of the scale of cerebral palsy we see children who are normally intelligent and capable of profiting from education, at the lower end of the scale, where brain damage has been more severe, cerebral palsy merges imperceptibly into the vast field of mental deficiency". Generally accepted figures are that 50% of children with cerebral palsy have normal intelligence, 25% are backward, and 25% are ineducable. Of the 75% who are educable, it is reckoned that 25% will be able to attend normal schools and 50% special schools. In the pure athetoid type of cerebral palsy and that which results from Rh incompatibility intelligence is commonly normal.

There are other known associations which may be helpful in diagnosis, assessment, and prognosis. Partial deafness often follows icterus gravis. Epilepsy complicates spastic hemiplegia and diplegia more commonly than the other types; its presence denotes a severe cerebral lesion and lessens the likelihood of normal intelligence. Anoxia and prematurity in association tend to cause diffuse damage. The incidence of congenital dislocation of the hip in cerebral palsy is about 3%.

ASSESSMENT

The prerequisite of adequate treatment and management is full assessment of the child. Great care must be taken to ensure that no part of the total handicap remains undetected. For research purposes a full neurological examination with lumbar puncture, ventriculogram, and electroencephalogram has been advised by some authorities. It is certain that the advance of knowledge of cerebral palsy depends on the collection of more facts and fewer theories.

Motor Assessment

The motor assessment presents considerable difficulties. The degree of motor dysfunction can vary greatly, depending on such factors as the emotional state of the child, tiredness, minor illnesses, etc. The degree of disability alters considerably with the stage of development. Also when it comes to describing the findings it is difficult to find terms which are not open to misinterpretation. The assessment of motor function is of necessity time-consuming. This should be done by the physical medicine specialist in company with the physiotherapist who is responsible for the locomotor treatment. Neither the doctor nor the physiotherapist, during undergraduate training, has been taught how to examine these children adequately. Nor is there a standard technique of examination acceptable to all workers in the field. To say that the child should be warm and comfortable with a minimum of clothing, and feeling secure in that he knows and trusts the examiners, is to state the obvious. However, many of these children are still condemned by the educational authorities after a brief assessment under conditions where it is impossible for them to perform well. Locomotor function varies greatly with positioning; distribution of tone can be quite different in the prone as compared with the supine position. Traditional posture for neurological examinations is the supine, but to examine the child in this position only is wholly inadequate.

One of the functions of locomotor assessment is to demonstrate the stage of locomotor development the child has reached, and then to determine why he is not progressing to the next stage. The positions in which the child has the best chance of accomplishing the movements

necessary for progress have to be ascertained. Because of language inadequacy, recordings of the examination should be made with film and tape recorder.

Intellectual Assessment

The intellectual assessment demands enormous patience and no little ingenuity, as well as long experience of the difficulties which beset the various types of cerebral palsied children. As so much of the management and treatment depends on the patient's intellect, its accurate assessment at the earliest possible moment is of vital importance. In assessing I.Q. the psychologist, the teacher, the occupational therapist, and the parent all have a contribution to make. Assessment must be repeated at intervals. It will be found that improvement from one aspect of development will lead to all-round improvement. For instance, after the correction of partial deafness with a hearing aid, intellectual development may proceed very rapidly. Once again the dangers of a brief assessment, and its unfairness to the patient, must be stressed. By the time the child is nearing school age the education authorities and the parents should have arrived at an assessment which will be acceptable to both parties and fair to the child. There will be a number of children on the border-line of educability, upon whom opinion may vary. For the assessment of these children—and this applies particularly to those who live deep in the country—residential facilities should be established where unhurried testing can be undertaken. In this way the number of unfair and inaccurate decisions will be reduced to a minimum. Some such centres have been opened. The staff of these centres must be of the highest calibre. It is well recognized that to remove a disabled child from his parents is a serious and often damaging emotional experience for which there must be a very good reason.

Visual and Auditory Assessment

Visual and auditory assessment should be done as early as facilities permit. A disorder of either sense can, as an additional handicap, enormously retard the progress of the cerebral palsied child. Hearing aids and glasses can be worn at a much earlier age than was previously realized. The wearing of an aid at the age of one year is now possible, and it is fascinating to see how much a deaf child values his appliance.

High-frequency deafness can present a real difficulty. It is often missed. Parents may miss it and the mother may strongly deny that her child is deaf. The child may hear a variety of sounds and hear them acutely, but repeated audiometry may reveal a partial deafness which may account for retarded speech and backwardness. The causes of visual defects, however, tend to be central rather than peripheral. It is probably true to say that cortical blindness leads to mental deficiency. Ocular testing is made difficult by the inattention of young children.

Perceptual Defects

Recently it has become more generally realized that a number of children with cerebral palsy have defects of perception. They do not fully realize the relation of themselves to their surroundings. The higher cortical sensory analysis may be deficient, leading to inability to appreciate such things as distance, weight, and texture. The occupational therapist and teachers should between them study and treat this type of disability. American authorities stress that it is important to discover the dominant hand at an early age, and to encourage its use, even if it is easier for the child to use the other hand.

TREATMENT

The special knowledge which is needed to treat cerebral palsy, as also for its diagnosis and assessment, covers so wide a field that it is essential, wherever the condition is treated, that an adequate and interested team be built up. The paediatrician, neurologist, neurosurgeon, physical medicine specialist, the orthopaedic, E.N.T., and ophthalmic surgeons, the psychologist, physiotherapist, occupational therapist, speech therapist, the teachers and the almoners—all have their role. There must, however, be one member of the team who will be responsible for the co-ordination of the efforts of all. He must have adequate time to spend on this difficult and time-consuming work. He must have time to meet and know all the members of the team; he must know exactly what they are trying to do; he must know their problems and work out happy relationships between them. He must get to know the children and the parents. He will be concerned in the co-ordination of any research programme. He must see that complete and accurate records are kept concerning every patient. In this connexion he may have to find time for film-making and sound-recording. He must establish a close liaison with the educational authorities and the local health, welfare, and housing departments.

Within the National Health Service there is an unfortunate tendency for medical staff to be burdened with so much minor administrative detail that no time is left for experiment or research. A team without a co-ordinator will not flourish. Members of a team must meet frequently to assess progress, to decide on management, to plan research, and to adopt a common line when dealing with both children and parents. There is nothing more distressing to parents than to receive conflicting advice from members of the same team.

Aims of Treatment

At a conference on "Children in Democracy" convened by President Roosevelt in 1940 he issued the following challenge: "Not only for its own sake but for the benefit of society as a whole, every crippled child has the right to the

best body which modern science can help it to secure, the best mind which modern vocational guidance can give, the best position in life which its physical condition will permit, and the best opportunities for spiritual development which its environment affords."

It is well to ask, "What is treatment trying to achieve?" The aim is an educational one—to fulfil the child's maximum potential in body, mind, and spirit. We are not called on to treat a symptom or a disease, but to educate whatever part of the nervous system remains functionally useful. A certain amount of "treatment" may be needed for any complications which may arise, such as epilepsy and severe orthopaedic deformities. Psychological "treatment" may be needed to deal with the emotional disturbances that are all too common.

Education depends on sensory and motor experience, and it is towards providing these children with normal experiences that efforts must be directed. The cerebral palsied child lacks normal locomotor experience and so lacks motor "learning". To this handicap may be added lack of normal experience in other forms of perception. The disabled child has to acquire the same experiences as a normal child, and should, if possible, acquire these at the right time, in the right sequence, and in a normal manner. It is unreasonable to expect a child to climb the developmental ladder without putting his foot on every rung. In the past, errors of management have certainly occurred in this respect. It is therefore very important that all who treat these children should have a sound knowledge of the normal child and his development. It is fair to say that a teacher's training has adequately prepared her for teaching cerebral palsied children, but the basic training of both physiotherapists and occupational therapists is inadequate in that, apart from their lack of fundamental neurological knowledge, they have never been taught to teach.

The task before the team, therefore, is to assist the child to acquire those sensory and motor experiences which the normal child acquires, and to perform and gain control of those movement patterns which go to build up normal movement. These objectives have to be achieved with as little loss of time as is reasonably possible. All authorities are agreed that the earlier treatment starts the easier and more successful it is likely to be. Volitional movements begin with the realization of movement, and are acquired and consolidated by constant repetition and by trial and error. The disabled child must be allowed to feel, see, hear, and explore as much as possible. These children have a long road to travel, and the earlier they make the right start the sooner they will gain the results required. Treatment must be designed individually. In my own opinion contractures are the result of inadequate treatment and are preventable. Bad movement habits, once acquired, make the building up of normal movement pattern doubly difficult.

Methods of Treatment

Opinion as to how the task can be best accomplished has been evolving rapidly in the last fifteen years. It is noticeable that those who are regarded as authorities in this field are each slowly accepting more and more of the ideas of the others. One can wish for quicker progress in this broadening of the field of agreement, but on the whole the signs are encouraging. It is proving difficult to organize adequate training of therapists in the absence of agreement. It seems that it may be left to the second generation of expert therapists to sort out the best from all systems and to include it into one common system of treatment. The orthopaedic approach of the past, so far as locomotor education is concerned, has largely given way to the neurophysiological. There are two diverging schools of thought which remain to be reconciled. Neither is incompatible with the two fundamental features of central nervous system activity described recently by Ritchie Russell (1958)—namely, the urge to repeat and the capacity to facilitate what is advantageous. The one holds that the best way to learn to move is to move, however badly, hoping that, with the acquisition of more skill, the movements acquired will become more functionally useful. The other school of thought holds that normal functional skills are based on normal primitive movements. If the primitive movements are not correctly acquired, any attempt to build up more complicated normal patterns cannot succeed. The recent realization of the enormous disability that a sensory defect can produce is, however, accepted by all.

Children with cerebral palsy, until Phelps and Carlson (himself a spastic) began to hold out some hope, tended to be abandoned as hopeless by the medical profession as a whole. Parents who insisted on something being done could find surgeons who attempted to control the spastic contractures by operation. Cases are on record where as many as sixty tenotomies were performed on one spastic child. The parents might also have employed a physiotherapist who, unenlightened, devoted her time to the periphery, having no conception of how to tackle the fundamental neurological defects. These children were largely excluded from normal education.

Phelps realized that some of these children were normally intelligent, that some without help had gained a place for themselves in the world, and that many more could, with help, follow the same road. He based his treatment on a detailed assessment of the voluntary control of the peripheral musculature and on the distribution of abnormal muscle tone. For the young "spastic" repetitive movements to music were advocated, passive at first, later progressing to active movement. Where athetoid movement was present, training in relaxation was insisted upon. From the completely relaxed position muscle control was developed, first in and around the larger joints and progressing to finer, more

skilled movements. This training was a great advance, and was particularly successful with the more intelligent group of children. However, the method depended too much on conditioned activity. When conditions were unfavourable the motor control tended to break down. Phelps advocated the use of bracing to prevent or correct deformity in a spastic and to control movement in the athetoid, and he developed the use of special furniture and mechanical aids to assist in the acquisition of normal posture, of balance, and of locomotor skills. Pollock (1957) states that "intelligent bracing is effective in lessening spasm, in controlling involuntary movement, and in providing that necessary support without which balance and progression may not be acquired". Not all authorities will agree with this, and some would regard the resort to bracing as a necessary evil when impatience demands quick results. In my own opinion, however, the orthopaedic approach still has a part to play in the treatment of the child who has not had adequate treatment when young. But it still needs to be said that to try to make the child stand before he can sit, and to walk before he can stand, is to show a fundamental lack of understanding of the problem.

Carlson's main advocacy has been to encourage the education of these children, taking great care to avoid the frustrations and emotional conflicts which surround them. The child is a child first with cerebral palsy superimposed, and as such needs all the requirements of a normal child. A child must, he says, at all costs be provided with some way of expressing himself, be it by speech, writing, or typing. A remarkable example of this is a highly intelligent but very disabled boy who was regarded by all as being dull and backward until a method of communication was worked out whereby he used his eye movements to answer the questions asked. Once communication was established the boy was altogether different, and his education is now proceeding apace. Carlson believes that, given the right education and the incentive that education provides, improvement in locomotor function will follow. He says it is the child's own sense of personal worth which must above all be fostered. He encourages play and organized games and, in an atmosphere as free from emotional conflict as possible, strives to develop purposeful movements.

Dr. Temple Fay introduced the use of the primitive spinal reflexes into the treatment of spastic cerebral palsy. He postulates that, as the normal cortical control of voluntary movements has been so severely damaged, recovery must depend upon the development and use of those primitive patterns of movement which are located in the undamaged midbrain and spinal cord. By passive and later active homolateral or amphibian movements progressing to crossed or reptilian movements, movement patterns are established and the remaining cortical cells experience some normal proprioception. The performance of these

movements demands the skilled services of at least two physiotherapists. These manœuvres have not found much favour in this country.

Mrs. Eirene Collis studied with Phelps, and first introduced his ideas into this country some fifteen years ago. Since then she has done much pioneer work herself, and is concerned with one of the largest clinics in the country. She stresses the importance of early diagnosis and of the "management" of the child and of his total environment. The purpose of this "management" is "to enable the affected children to make the best possible use of their defective activity for the purpose of living". The use of movements for voluntary purposes begins normally in the early months of life. Children with motor disorders are denied effective relationship between mouth and eye and hand and foot. Management, says Mrs. Collis, must be designed in the early months to assist this relationship and later to assist achievement. Achievements demand controlled movements, therefore physiotherapy must be directed to movement control. Acquisition of movement control involves attention from the child, and this attention is, according to Mrs. Collis, a direct product of the intellectual capacity. The child's progress depends, therefore, on the guided exploitation of his learning ability. By ensuring that the child's attempted activities are just within the range of his competence, voluntary movement skill will best be developed. Once again the importance of achievement is stressed. Deformities arise because and when the child cannot change from one posture to another, and for this reason constant alteration in posture must be insisted upon. Mrs. Collis lays particular stress on parental guidance. Some details of her management programme can be found in the recently published *The Infantile Cerebral Palsies*.

The functional approach stressing the total management of the child and of his surroundings is emphasized by Perlstein (1956) and again by Deaver. Professor Plum (1956), of Copenhagen, emphasizes the importance of the disabled child climbing the normal ladder of locomotor experience and of education. He lays great stress on the education of the parents.

The neurophysiological treatment developed by Kabat is essentially intended for treatment of dysfunction of the lower motor neurone. Some of his techniques, however, may prove useful in the rarer hypotonic forms in strengthening muscles which are weak through disuse, and in promoting relaxation and lengthening of spastic muscles through reciprocal innervation. It is probably wise for a physiotherapist treating cerebral palsy to have some knowledge of his work.

Dr. and Mrs. Bobath have been evolving a method of treatment based upon the suppression of abnormal tonic reflex activity by reflex-inhibiting postures, followed by facilitation of normal movement patterns by the use of righting and balance reactions and other protective reactions. They demonstrate that the

abnormal distribution and strength of muscle tone at rest and during movement is a disorder of reflex function, and that this abnormal tone can be varied and to a certain extent modified and controlled. When the muscle tone is made more normal the child may be able to perform and experience a movement not experienced before; then by repetition a new voluntary movement pattern can be established, gradually needing less and less help in its performance.

Mrs. Bobath stresses the importance of starting treatment at the earliest time. Not only is it in the early years that unsatisfactory movement patterns become established, but it is known that the normal brain trebles its weight and volume during the first two years of life. It is vitally important that as the higher centres begin to function they should do so on normal rather than abnormal lines. With a sound knowledge of how the child should be moving at different ages, and by analysing his deficiencies and difficulties, the abnormal reflex activity which is interfering with his normal progress is demonstrated. Reflex-inhibiting postures are worked out for each patient and in many positions.

In these postures the interference of pathological reflex activity is diminished, muscle tone becomes more normal, and higher subcortical and cortical activity can break through (facilitation). Slowly then higher movement patterns progressing up the normal ladder of development are encouraged and in time become established. This is the path of normal development. In this way an attempt is made on sound neurophysiological principles to maintain the child on a normal developmental path. As so often happens, language has been inadequate to convey, without confusion, a new set of ideas. When the Bobaths use the term "reflex-inhibiting postures" they use the word "reflex" correctly, but to include tonic reflexes as well as the spinal reflexes.

As reason and thought develop the child must be made to understand his treatment and his interest be maintained. He must enjoy his treatment. A treatment programme need not be strict, but whatever is done must be recorded accurately and full progress notes must be kept.

All who treat these children emphasize to a greater or less degree the importance of the home, of the mother, and of the child's social background.

Speech therapy should be the province of a trained speech therapist. However, she will need considerable guidance in understanding the total problem and of the part she has to play in relation to the rest of the team.

Many drugs have been tried to reduce spasticity or to diminish involuntary movement. Myanesin (mephenesin), Mysoline (primidone), Lysivane (ethopropazine), Artane (benzhexol), chlorpromazine, scopolamine, Camadrin, and alcohol have all been found to have no more than a temporary effect. In the upbringing of a child drugs probably have no part to play. However, intelligent adults suffering from various types of cerebral palsy have found that certain drugs or

combinations of drugs will help them, used not continuously, but only in times of special need.

Surgery may have a small part to play in the treatment of the severely affected hemiplegic in infancy. Papers by Krynouw, Cairns, and McKissock have described the indications and results. The place of surgery in some forms of tremor and athetosis has recently been studied.

There are some teaching principles which apply especially to the upbringing of cerebral palsied children: the growth of learning cannot transcend the limits imposed by the stage of maturation that the individual has reached; the goal must be made attainable; frustrations will be diminished by praise and by reward. Learning is proportional to the frequency with which the learning factors are made operative. A task with meaning is easier to learn than simpler tasks if they are meaningless. The desire to be like others, to impress one's social group and to receive their approval provides a most fundamental human motive.

DISCUSSION

The questions of main concern to physical medicine with regard to cerebral palsy are:

(*a*) Has traditional physiotherapy anything to offer?

(*b*) If not, is there a need for physical treatment of a different nature?

(*c*) What can and should be done to provide and to improve training?

(*d*) If physiotherapy and occupational therapy have a part to play, how big and important a part is it?

In respect to the first question any physiotherapist who has not taken special postgraduate training will, if she is honest, admit that her training has left her unprepared to deal with a case of cerebral palsy even when given guidance on broad principles. Likewise the routine training of a doctor is also inadequate in this respect. There is a body of opinion which holds that physiotherapy can be dispensed with so long as the parents are given the right advice on general management and on the positioning of the child. While correct advice is infinitely better than inefficient physiotherapy, this attitude is surely a very negative and uninformed one at the present time. It must be increasingly recognized that intelligently applied neurophysiological treatment has a big part to play, and that its application is the function of a physiotherapist who has received special training. To progress from the present confusion about treatment several steps are necessary. Decisions have to be made as to the minimum knowledge—developmental, neurophysiological, practical, and social—that a physiotherapist needs to acquire before undertaking the treatment of cerebral

palsy; also whether this knowledge should be acquired before or after qualification. In my view this is postgraduate work which should be undertaken only by the few and by those who are temperamentally fitted for this arduous work. If this demands postgraduate education, some more efficient way must be found to organize and finance it. Possibly an Institute of Postgraduate Physiotherapy would provide the answer. It is certain that cerebral palsy will always be with us, and hence it will be to the advantage of all concerned to put the specialized treatment required on the soundest possible foundation. A financial incentive to postgraduate training in the subject might be the introduction of a paid cerebral palsy qualification comparable to the present one in hydrotherapy. It is becoming clearer that physiotherapy should play a big part in the pre-school years—that is, during the time of maximum locomotor development. With more efficient treatment in the early years the need for treatment in later years should be less. As the education of these children is so important, the less time they need to spend on locomotor education at the expense of formal education the better.

So far as "management" is concerned, and as there is no one specially qualified for the job, this will fall to the lot of whoever has the necessary experience and interest. But whoever accepts the role, be it paediatrician, general practitioner, physical medicine specialist, physiotherapist, or teacher, it is very important to provide continuity.

It is generally accepted that early diagnosis and the early initiation of treatment are of vital importance. Much more must, therefore, be done in the field of propaganda and in the local dissemination of information about the facilities available. More could be done in the way of routine follow-up of all children born prematurely or who have been involved in circumstances predisposing to neurological damage. The attitude of mind which says "wait and see" must give way to a more positive approach. The main difficulties with regard to early diagnosis and treatment lie in districts remote from big centres of population, where it is difficult to assemble the experience and special knowledge needed to form a worthwhile diagnostic advice and treatment centre.

The epileptic cerebral palsied child not only has a reputation for being of low I.Q., but is unwanted at a cerebral palsy centre because of his epilepsy, and at an epileptic institution because of his locomotor handicap.

Cerebral palsies with other combinations of multiple handicaps present special problems. Sensory handicaps together with a physical disability so restrict mental development that severe backwardness is inevitable unless the sensory defect is discovered and treated early. A child is still too easily given a label of "mentally deficient" or "ineducable" when he is merely grossly handicapped. Many such children have unfortunately in the past found their way into

institutions for mental defectives. How many of the educationally subnormal children are subnormal because the reason for their backwardness has not been discovered and corrected at an early age? As regards the education of the child with a multiple handicap, it is now realized that to deal with the problem satisfactorily educational method and equipment have to be tailored to fit each child. This usually involves delay—delay which is over and above the time wasted waiting for the child to reach school age. These children with multiple handicaps have a long road to travel, and it is reasonable to expect the education authorities to begin their education well before the age of 5. More special pre-school clinics should be set up, like the one recently opened in Tottenham by the local authority with the Minister of Health's approval.

Children unable to benefit from education in normal or special schools should be cared for in occupational centres. The recent report of a Royal Commission should lead to a more positive and sympathetic approach to this problem.

The occupational therapist, like the physiotherapist, is not specifically trained to tackle the problem of the cerebral palsied child. She can, however, make a most significant contribution. It can be her function to instruct the children and the parents in the correct performance of the routine activities of daily life. She can advise on craftwork and play at home, and can help a great deal towards the socialization of the children in her care. Puzzles, games, etc., can be specially constructed to aid the acquisition of skills, both sensory and motor. Obviously the occupational therapist must work very closely with the teacher, the speech therapist, and the parents; their territories overlap. Not only do these children as they grow up need to be functionally capable, but also, and most important, they need to be socially acceptable. In later years the occupational therapy department can help with vocational guidance and prevocational training. There is one handicap which possibly comes specifically within the sphere of the occupational therapist—namely, the assessment and treatment of a space-perception defect.

Should the school come to the treatment centre or vice versa? The educational techniques and equipment are becoming so specialized and teamwork so necessary that it is important that all the facilities should be gathered under one roof wherever this is possible. The establishment should be under medical rather than educational direction, with the educationalists given a large share of responsibility. Parents must have a much closer link with the establishment than parents would normally maintain with their child's school. They must be encouraged to unburden their fears and frustrations and to accept the help which they cannot get elsewhere. A great deal must be done to educate and encourage the parents. Theirs is a heavy social burden which must be lightened in every possible way.

The social problem and the parent–child relationship need skilful handling. The enforced prolongation of the child's dependence on its mother; the social isolation of the child; the problem of the single-handed mother; the difficulty of the parents getting away from their child even for a brief holiday; non-acceptance of the child by other members of the family; parental guilt feelings and their fears about further children; the child's emotional outbursts due to frustration—these are some of the problems which contribute towards an abnormal emotional environment for the child's upbringing.

Special furniture and its function is a vexed question. If special furniture is useful for the acquisition of special skills, let it be used for that purpose only; and even then only during the right stage of development. There is a tendency for special furniture to be used too much, even to such an extent as to cause contractures; for the sake of the parent's convenience the child may spend its time strapped in a special chair when he should be given the freedom of the floor.

Is better work done in a special building? There is something to be said for a building specially furnished for handicapped children.

Finally, a word on behalf of children with low-grade cerebral palsy. These may not be able to benefit from those forms of treatment which require a high degree of attention in order to acquire skill. But their parents should not in consequence be excluded from any advice centre set up. The parents are entitled to the best possible advice to enable them to exert the right influence on the child's upbringing. They may be able to make him socially acceptable where without help this limited aim would be unattainable.

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OBITUARY

C. J. S. O'MALLEY, C.B.E.

THE sudden death of Group Captain O'Malley on January 25 at the height of a distinguished career came as a grievous shock to his world-wide circle of friends, colleagues, and patients.

Charles James Sidney O'Malley was born in Australia in 1901. Educated at Wellington College and St. Thomas's Hospital Medical School, he qualified in 1925 and completed the London M.B., B.S. ten years later. Joining the Royal Air Force Medical Branch in 1926, he saw service in many parts of the world before initiating in 1940 the R.A.F. rehabilitation service at the Officers' Hospital, Torquay. He was appointed principal medical officer of the Desert Air Force a year later and distinguished himself by his organization of the air evacuation of casualties. In 1944 he was appointed C.B.E., and returned home to command the R.A.F. rehabilitation centre at Loughborough. Soon he was in charge of a further six centres and became widely known as an exponent of medical rehabilitation.

In accordance with Service practice, he had to revert to general administrative duty in 1947, but his heart remained in the rehabilitation centres for which he had done so much. In 1950 he resigned from the R.A.F. to take up an appointment as adviser in physical medicine and rehabilitation to the North West Metropolitan Regional Hospital Board and first director of the Medical Rehabilitation Centre at Garston Manor, Watford. The centre was an immediate success, and O'Malley's advice was soon in constant demand at home and overseas. Although in a busy full-time post, he somehow found time to answer all appeals for guidance and practical assistance. Honorary appointments and special assignments followed in rapid succession. He became consultant to the World Veterans Federation, chief assistant to the late Harold Balme in the organization of international study courses in rehabilitation, and Regional Medical Adviser to the Ministry of Labour and National Service. On behalf of the World Health Organization he visited Cairo and Rome to advise on the development of rehabilitation centres, and for the past year he had been engaged in the preparatory work for a Committee of Experts in Medical Rehabilitation due to meet at Geneva, also for a further international study course to be held in the autumn under the aegis of the British Council. Shortly he was to have visited India at the invitation of the Indian Government.

In 1954 he opened the Medical Rehabilitation Centre, Camden Road, the first out-patient centre in London. This centre he regarded as his best achievement, because he had mastered the inherent difficulties of creating in a non-residential establishment the community spirit and the attitude of victory over disablement, to which he rightly attached so much importance. In 1956 he resigned from Garston Manor to take up the appointment of consultant in physical medicine at Queen Mary's Hospital, Roehampton. He was engaged in developing the rehabilitation services of that hospital when death brought his work to an untimely end.

Jamie O'Malley was a distinguished officer and acclaimed as a pioneer in the field of medical rehabilitation. As such his name and teaching will endure; but his many friends and colleagues of all ages will treasure also the memory of his personal qualities. He was a big man with a heart to match. His infectious good humour,

enthusiasm for his work, and willingness to respond to all appeals for help endeared him to everyone. He was a natural leader and notably loyal to his colleagues and subordinates. He had a flair for selecting his teams and getting the best out of all members. In his latter years he identified himself and his work with physical medicine to the great advantage of the specialty. His place can never be filled, but the memory of his example will inspire the younger men he trained and for whom he did so much. There is no doubt that he worked himself to a premature death in his untiring efforts to further the interests of his patients, colleagues, and assistants,

As a family man he was devoted to his wife and two daughters, to whom we extend our deepest sympathy. After long hours of hard work during the week in London, he drove down at week-ends to relax in a charming manor house in the little village of Bishopstone in the foothills of the Sussex Downs. He is buried in the adjoining churchyard of St. Andrew's, an ancient parish church in which he took a great interest.

F.S.C.

REVIEW OF BOOK

PROCEEDINGS OF THE SECOND INTERNATIONAL CONGRESS OF PHYSICAL MEDICINE, COPENHAGEN, 1956. *Pp. 644. Copenhagen: H. Behrndt and Co. 1957.*

This book, of some 600 pages, gives a complete account of all the papers presented at the International Congress, and a great deal of painstaking work has gone into its presentation. Many of the ideas expressed by certain workers would not find general acceptance in this country, especially those concerned with the concept of fibrositis as a separate entity and with the therapeutic value of ultrasonics. The papers regarding rehabilitation of the handicapped patient, whether from trauma, poliomyelitis, or upper motor neurone lesions, cover a great deal of ground and give a comprehensive picture of what can be achieved and what can be expected in the way of recovery, although with some of the presentation the statistical approach leaves room for improvement.

Considering how much work of the physical medicine specialist is concerned with the rheumatic diseases, surprisingly few papers were presented dealing with this aspect.

The book, in all, is rather patchy, and although some of the papers presented are of considerable interest, many lack the critical approach in their form and content which might be expected before presentation to a scientific audience such as an international congress. While serving as an illustration of the wide scope of physical medicine, it also draws attention to the need for a more scientific attitude.

E. N. COOMES

ABSTRACTS OF THE LITERATURE

The Expenditure of Energy by Men and Women Walking. J. BOOYERS and J. R. KEATIURGE. *J. Physiol.*, 1957, **138,** 165.

The energy expenditures of ten men and ten women while walking have been measured to find out (1) the range of individual variation, and (2) whether there is a sex difference.

Walking at 5·47 km. per hour, women expended significantly less energy than men per unit of body weight; they took significantly more strides per minute and also significantly shorter strides than men. When the subjects walked at 6·44 km. per hour the difference in expenditure of energy between the sexes was even more significant. Walking at 5·47 km. per hour, women expended on an average 0·44 kcal./kg./hr. less than men, whereas the difference was 0·74 kcal./kg./hr. at 6·44 km. per hour.

It is concluded that there is considerable individual variation in the expenditure of energy for which it is difficult to single out any specific cause.

M. F. HART

Errors of Diagnosis Revealed at Meniscectomy. G. MURDOCH. *J. Bone Jt Surg.*, 1957, **39B,** 503.

It is always salutary to review errors in diagnosis. This paper from the Royal Infirmary, Dundee, presents an analysis of the causes of wrong diagnosis in 119 cases of arthrotomy for suspected cartilage tears. This represents a 4·5% incidence of cartilages which had no detectable lesion in a series of 2,668 meniscectomies, and serves to point to the decreasing incidence of error during recent years.

The commonest cause of error was an unreliable witness (32 cases), and the largest group of these patients (22) were malingerers or interested in compensation for an alleged injury. The second largest group were errors of location. All except one involved the medial cartilage, and half were also associated with damage to the anterior cruciate ligament. Other causes of error included: torn anterior cruciate ligament (9), quadriceps insufficiency (8), recurrent subluxation of the patella (8), loose bodies (4), chondromalacia patellae (4), and abnormality of fat pad (3); 17 cases were unexplained. Recurrent subluxation of the patella is regarded as a particular source of error in women.

[This study emphasizes how difficult the diagnosis of a cartilage lesion may be and how careful the history-taking and examination must be. It also emphasizes the value of a rehabilitation unit in "proving" or provoking the knee, and in building up the quadriceps after previous injury before further operation is contemplated.] P. J. NICHOLS

Compression of Median Nerve in Carpal Tunnel and its Relation to Acroparaesthesia. H. GARLAND, J. P. P. BRADSHAW, and J. M. P. CLARK. *Brit. med. J.*, 1957, **1,** 730.

The authors discuss the diagnosis, prognosis, and treatment of acroparaesthesia, together with the underlying mechanism of this condition, on the basis of a study of 53 cases selected because symptoms were confined to the hands and digits, although radiation to the forearm was recognized as a variant. The presence of other neurological abnormality necessitated rejection from the series. Female patients predominated (46).

Pain was almost invariably referred to the territory of the median nerve, and electromyographic and ischaemic sensory tests lent support to this localization of the lesion at the wrist. Rest alone may relieve symptoms, but relapse may occur.

In 35 patients operation invariably produced dramatic relief of symptoms with improvement of any existing neurological deficit. G. O. STOREY

Rheumatoid Spondylitis: A Clinical and Socio-economic Study. R. L. SWEZEY, J. PATTERSON, S. MARCUS, D. STRANGE, and M. H. LEVIN. *Ann. intern. Med.*, 1957, **47**, 904.

This paper, which is based on a study of 100 cases of rheumatoid spondylitis (ankylosing spondylitis) from a Veterans Administration hospital, gives a good account of the clinical picture and complications of the disease.

Most of these patients adjusted themselves best to a type of employment which did not demand heavy lifting, undue exposure or fatigue, or prolonged sitting (including driving) or standing. Patients who were self-employed or whose jobs permitted freedom of mobility or permitted them to work on their own seemed best adapted to the limitations imposed.

The incidence of peripheral joint disease was high and the main cause of disability. Two patients were totally disabled by these changes.

Regarding treatment, patients given steroids systemically seemed more benefited than those treated by X rays. Phenylbutazone gave good results in a small number initially, but had to be discontinued because of toxicity.

M. F. HART

Use of a "Double-Blind" Study Investigating the Clinical Merits of a New Tranquilizing Agent. H. KOTEEN. *Ann. intern. Med.*, 1957, **47**, 978.

The author carried out a careful evaluation of the propanediol derivative known as "miltown", most of the patients treated suffering from muscle tension states involving the neck, shoulders, or back. In 25 patients the effect of miltown was compared with a matching placebo by the "double-blind" method. The results showed that miltown, 1,200 to 1,600 mg. daily, had no greater effect than the placebo. M. F. HART

Glossopharyngeal Breathing: Its Value in Respiratory Muscle Paralysis of Poliomyelitis. W. H. KELLEHER and R. K. PARIDA. *Brit. med. J.*, 1957, **2**, 740.

In this paper from the Western Hospital, London, after a review of the literature on glossopharyngeal breathing (G.P.B.), the technique is described and six case reports presented.

According to the authors, G.P.B. may be regarded as a self-applied form of intermittent positive-pressure respiration, the air being forced into the lungs by a frog-like gulping action. Patients with severe respiratory muscle paralysis following poliomyelitis may develop the technique spontaneously or may be taught.

The volume relations between unassisted breathing and G.P.B., the effect of G.P.B. on chest expansion, and the "expulsive" force of expiration are tabulated. The results show that G.P.B. enhances the patient's ability to increase his vital capacity, making him less dependent on respiration, and it also increases his "expulsive" effort. The practical advantages include social and psychological benefit from the additional independence that G.P.B. brings.

P. J. R. NICHOLS

Multiple Myeloma: Current Clinical and Chemical Concepts. *Amer. J. Med.*, 1957, **23**, 283.

This is a symposium dealing largely with the pathological and biochemical aspects of multiple myeloma. [Those interested should consult the original.]

M. F. HART